

PROPOSAL FOR STUDY TO
CHANGE BEAMPIPE LAYOUT
TO SIMPLIFY B-LAYER
INSTALLATION

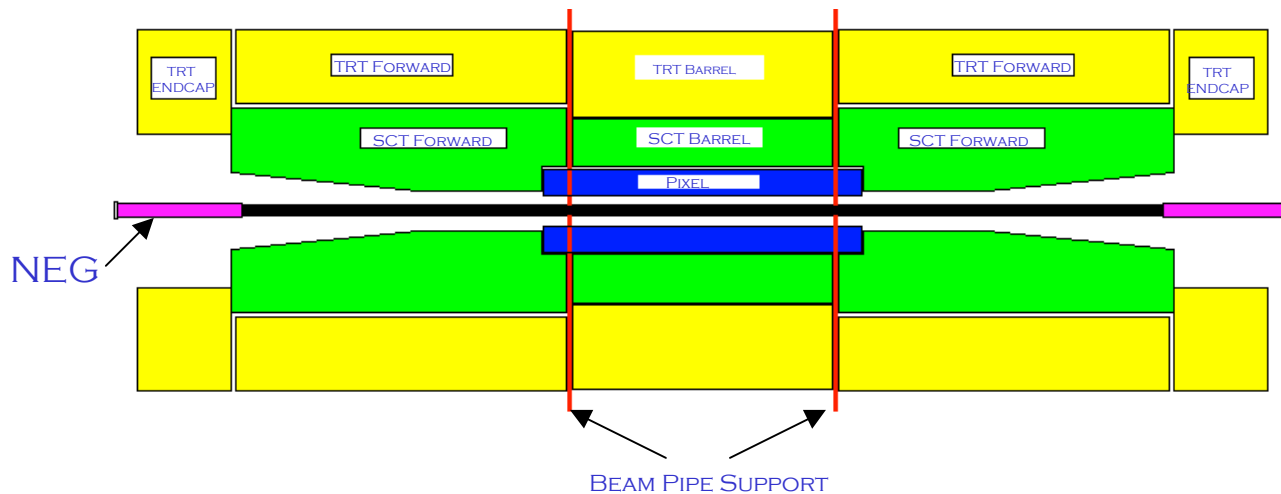
AUGUST, 1998

E. ANDERSEN, LBNL/CERN

CURRENT AND PROPOSED LAYOUTS

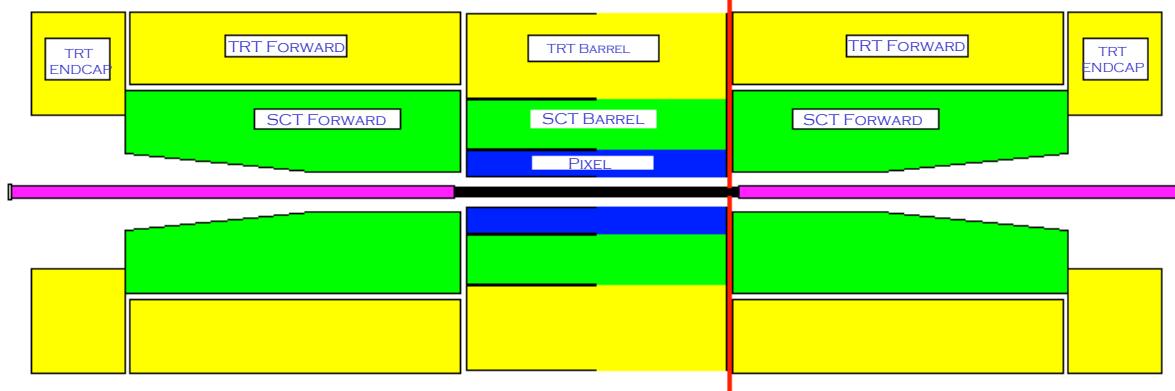
CURRENT LAYOUT:

- 2 SUPPORTS
- NEG AT ENDS



PROPOSED LAYOUT

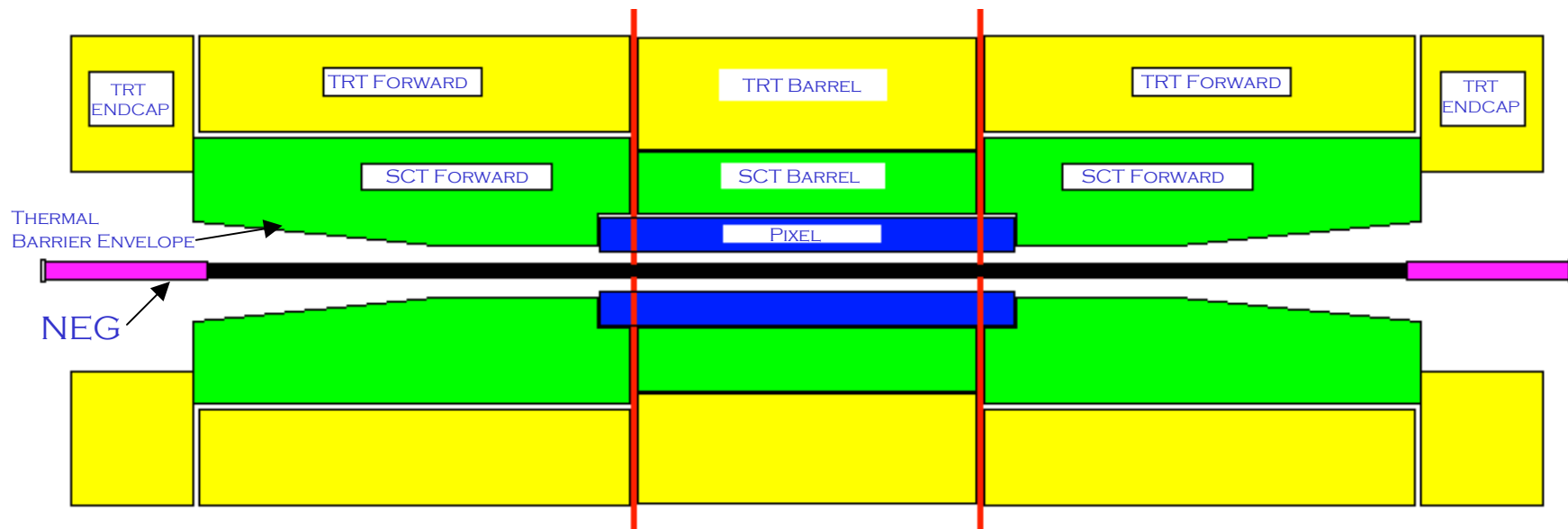
- 1 SUPPORT REMOVED
- NEG EXTENDED IN



PIXELS SHOWN IN POSSIBLE
SHRUNKEN CONFIGURATION
-NOT OFFICIAL

PIXEL DETECTOR

CURRENT LAYOUT

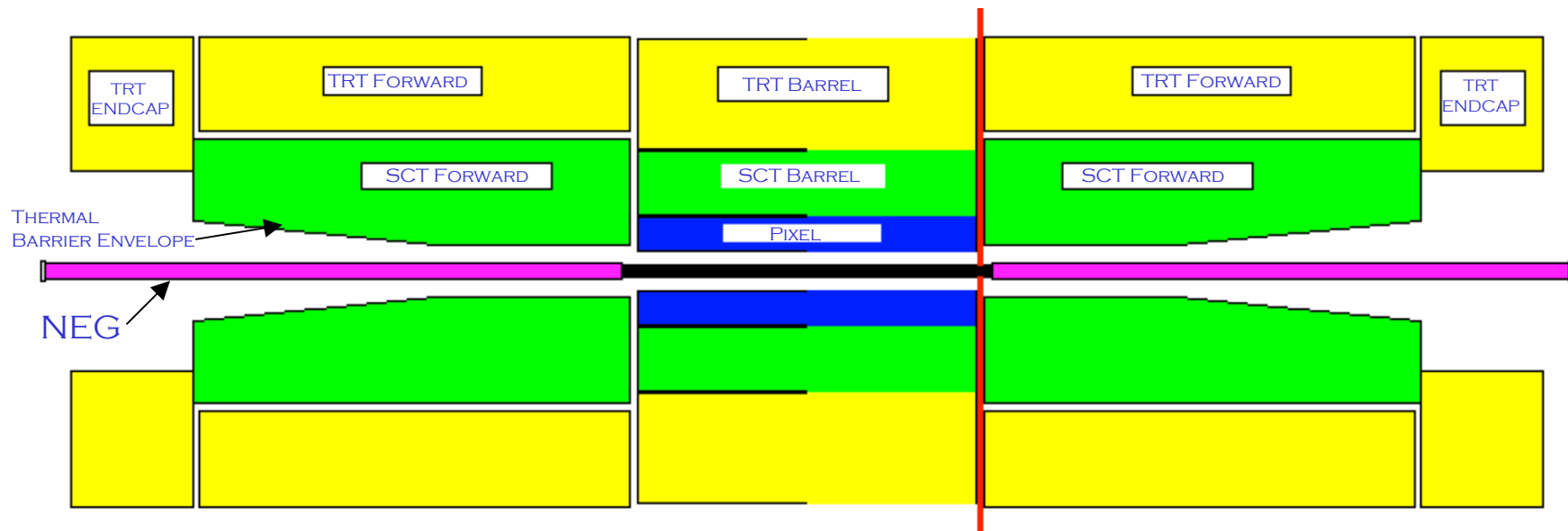


- **CURRENT LAYOUT LEADS TO MANY PROBLEMS WITH B-LAYER INSTALLATION**
 - MUST BE INSTALLED IN INDEPENDENT HALF-SHELLS
 - MUST BE REMOVED FOR EACH BAKEOUT
 - UNCERTAINTY IN FREQUENCY OF REMOVAL LEADS TO THERMAL BARRIER REQUIREMENTS

CURRENT LAYOUT PROBLEMS

- **B-LAYER IS INSTALLED IN INDEPENDENT HALF-SHELLS**
 - HALF-SHELLS ARE LESS RIGID, SO MORE MATERIAL IS REQUIRED TO DESIGN SATISFACTORY B-LAYER STRUCTURE
 - TOOLING IS COMPLEX TO ACTUATE HALF-SHELLS TOGETHER AROUND THE BEAM-PIPE SUPPORT FROM 3 METERS AWAY
- **B-LAYER IS REMOVED WHENEVER THERE IS A BAKEOUT**
 - B-LAYER CAN LAST FOR THE FIRST 6 YEARS OF OPERATION WITHOUT REMOVAL
 - EACH REMOVAL OF B-LAYER RISKS POSSIBLE DAMAGE TO ID
- **FREQUENT B-LAYER REMOVAL REQUIRES THERMAL BARRIERS**
 - B-LAYER REMOVAL AND BAKEOUT REQUIRE EXTENDED ACCESS TO BORE OF SILICON TRACKER AND PIXELS WHICH ARE NOMINALLY -15 DEG C (NEGATIVE)
 - UNCERTAINTY IN ACCESS TIMES AND FREQUENCY REQUIRE THERMAL BARRIERS TO ALLOW TRACKERS TO STAY COLD AT ALL TIMES/WARM-UP SCENARIOS ARE ILL-DEFINED

PROPOSED LAYOUT



- **PROPOSED LAYOUT IS PRIMARILY AIMED AT SIMPLIFYING INSTALLATION REQUIREMENTS FOR THE B-LAYER**
 - REMOVAL OF ONE BEAMPIPE SUPPORT ALLOWS FOR MORE RIGIDITY IN B-LAYER AS IT CAN BE FASTENED TOGETHER AROUND BEAM PIPE PRIOR TO INSERTION
 - MOVING NEG TOWARDS IP COULD REMOVE NEED FOR BAKEOUT OF THE CHAMBER ALTOGETHER

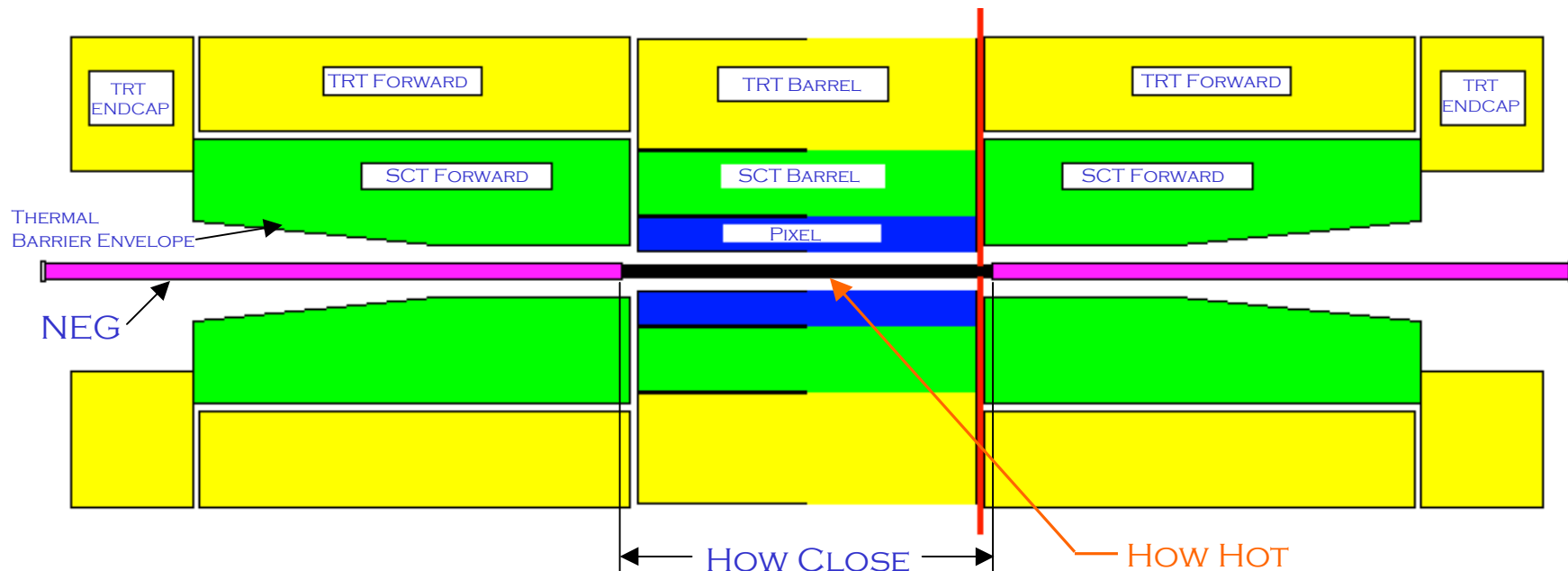
DIRECT BENEFITS OF PROPOSED LAYOUT

- **REMOVAL OF ONE BEAMPIPE SUPPORT SIMPLIFIES B-LAYER DESIGN**
 - B-LAYER CAN BE MADE FULL CYLINDER REDUCING MASS
 - TOOLING FOR B-LAYER INSERTION CAN BE SIMPLIFIED
 - DOES NOT NEED TO ACTUATE AROUND SUPPORT
- **EXTENSION OF NEG TOWARD IP REDUCES OR REMOVES BAKE-OUT REQUIREMENTS**
 - REDUCES FREQUENCY OF B-LAYER REMOVAL
 - NO BAKEOUT TOOLING IS NECESSARY (FURTHER SIMPLIFIES B-LAYER TOOLING)
 - POSSIBLE TO DO WITHOUT THERMAL BARRIERS
 - DUE TO REDUCTION IN FREQUENCY AND TIME OF ACCESSES

POSSIBLE* BENEFITS OF NEW LAYOUT

- **USE OF NEG JACKET TO SUPPORT B-LAYER DURING INSTALLATION**
 - LOAD/POSITIONING TRANSFERRED TO PIXEL DETECTOR UPON INSERTION VIA RAILS
 - B-LAYER IS UNDER 5KG-CURRENT ESTIMATE WITH SERVICES IS LESS THAN 3KG
 - SIMPLIFIES FURTHER THE INSTALLATION TOOLING FOR B-LAYER (LESS TO BRING THROUGH ALREADY IMPOSSIBLE ACCESS PORT)
 - REDUCES TIME TO INSTALL B-LAYER, FURTHER INCREASING THE LIKELIHOOD OF REMOVING THE THERMAL BARRIERS

NEED TO STUDY:



- **BENEFITS OF THE NEW LAYOUT ARE ONLY POSSIBLE IF CERTAIN PARAMETERS ARE WITHIN ACCEPTABLE LIMITS**
 - How CLOSE TO IP MUST THE NEG COME TO NEVER BAKEOUT THE BEAMPIPE?
 - DURING NEG REACTIVATION, How HOT DOES THE CENTER SECTION GET?
 - WITH ADDED MASS OF EXTENDED NEG, IS ONE BEAMPIPE SUPPORT FEASIBLE?
 - CAN A REDUCTION OF MASS AT LOW ETA BE TRADED OFF WITH INCREASES AT HIGH ETA? (CAN THERMAL BARRIER REQUIREMENTS BE RELAXED/REMOVED?)

WORK REQUESTED OF BEAM PIPE ENGINEERS

- **STUDY VACUUM STABILITY WITH NEG BROUGHT CLOSER TO IP**
 - ANSWERS REQUESTED
 - HOW CLOSE MUST NEG BE TO IP FOR NO BAKE OUT
 - HOW HOT WILL BEAMPIPE GET
 - HOW MUCH MATERIAL IS NECESSARY FOR NEG JACKET
- **STUDY STABILITY OF BEAM PIPE WITH ONE SUPPORT REMOVED**
 - ANSWERS REQUESTED
 - CAN CURRENT BEAMPIPE BE SUPPORTED FROM ONLY ONE SIDE OF IP
 - CAN PROPOSED DESIGN BE SUPPORTED FROM ONLY ONE SIDE OF IP
 - CAN B-LAYER BE INSTALLED USING BEAM PIPE IN *EITHER* CONFIGURATION
- **CONTINUE WORK TO REDUCE NEG REACTIVATION TEMPERATURE**

CURRENT WORK

- **WORK TO STUDY SECTIONAL STABILITY OF BEAM PIPE**
- **WORK TO REDUCE ACTIVATION TEMPERATURE OF NEG**
 - CURRENT STUDY TO REDUCE ACTIVATION TEMP TO 200C FROM 300C
- **WORK TO COAT NEG ON INSIDE OF BEAMPIPE**
 - RELATED TO ABOVE STUDY-REDUCES MASS OF NEG REGION
- **WORK ON NEG INSULATION JACKET/HEATERS**
 - BE OR CF VACUUM SLEEVE WITH MLI AND KAPTON-FOIL HEATER
 - POSSIBLE RELATED WORK ON THERMAL BARRIER HEATER DESIGNS
 - CURRENT DESIGNS RADIATE LESS THAN 15W/METER-LENGTH
- **THERMAL BARRIERS PRELIMINARY DESIGN WITH INTEGRATED HEATER**
 - HEATERS BEING PROTOTYPED
- **WORK ON B-LAYER DESIGN**
 - CURRENT DESIGN OPTIMIZES RIGIDITY OF HALF SHELLS
- **WORK ON B-LAYER TOOLING**
 - CANTILEVER DESIGN IS PIXEL TDR BASELINE
 - TECHNICAL COORDINATION TDR EFFORT WILL USE “CURRENT” LAYOUT
 - PROTOTYPING BEGINS SOON ON “FUNICULAR” AND PORTION OF RAILS

ITERATIVE EFFORTS BETWEEN ID AND BEAM PIPE

- **BEAM-PIPE SUPPORT**

- STUDY WHAT IS NECESSARY TO HAVE SUPPORTS ON ONLY ONE SIDE
 - THIS IS AN EXTREMELY IMPORTANT TOPIC, AND CAN BE MADE INDEPENDENT FROM THE NEG/BAKE OUT ISSUE
 - IN THE BEST OF ALL WORLDS-THIS WOULD BE A REQUIREMENT

- **MATERIAL TRADEOFFS**

- ESTIMATE MATERIAL REDUCTIONS IN FORWARD REGIONS
- OPTIMIZE MASS OF NEG JACKET
- CALCULATE EFFECTS OF ADDED MATERIAL (SCATTER/BACK-SCATTER)
- SHARE INFORMATION REGARDING WORK ON THERMAL BARRIERS

- **INTERACTION OF BEAM PIPE HEATING AND B-LAYER WARM-UP**

- COOLING CONSIDERATIONS FOR B-LAYER
- REDUCTION OF NEG ACTIVATION TEMPERATURE

CONCLUSION

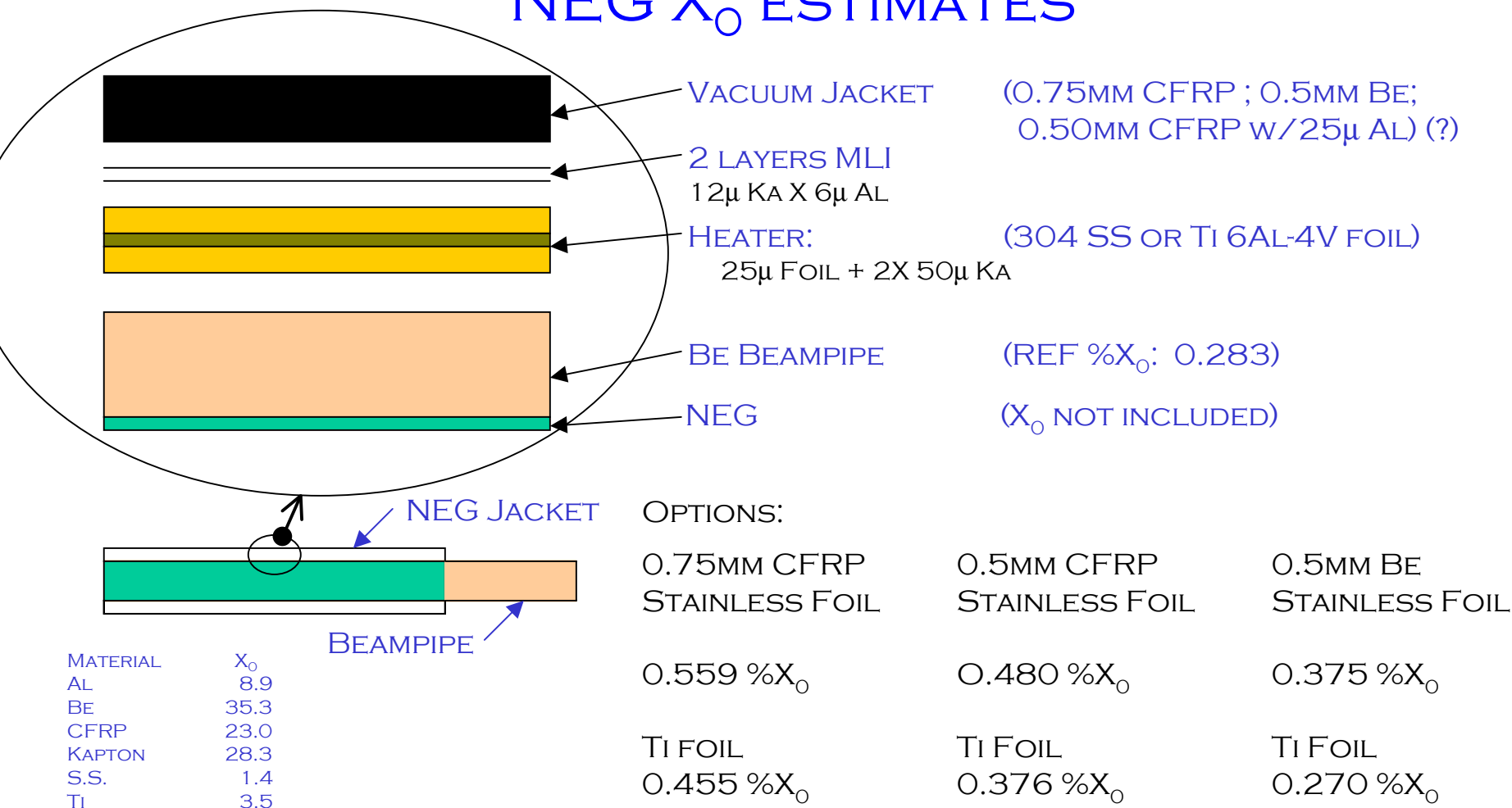
- **POSSIBLE BENEFITS**

- SIMPLIFY B-LAYER TOOLING
- REDUCE B-LAYER MASS
- REDUCE B-LAYER REMOVAL FREQUENCY
- REMOVE THERMAL BARRIERS IN INNER TRACKER BORE
- NEVER BAKE OUT
- REMOVE B-LAYER ONLY AT END OF DETECTOR LIFE TIME

- **TRADEOFFS**

- INCREASED MASS IN FAR FORWARD
- HOT BEAM PIPE NEXT TO B-LAYER
 - POSSIBLE REDUCTION IN B-LAYER LIFE
 - INCREASE IN B-LAYER COOLING MASS/COMPLEXITY

THE BENEFITS TO THE INNER DETECTOR ARE NUMEROUS. ACTUAL PARAMETERS ARE NECESSARY TO DETERMINE IF SUCH BENEFITS CAN BE HAD. ANALYSIS IS REQUESTED TO DETERMINE THE POSSIBILITY OF CHANGING “POSSIBLE BENEFITS” TO “DESIGN GOALS.”

NEG X_0 ESTIMATES

OPTIONS:

0.75MM CFRP
STAINLESS FOIL0.559 % X_0

Ti FOIL

0.455 % X_0 0.5MM CFRP
STAINLESS FOIL0.480 % X_0

Ti FOIL

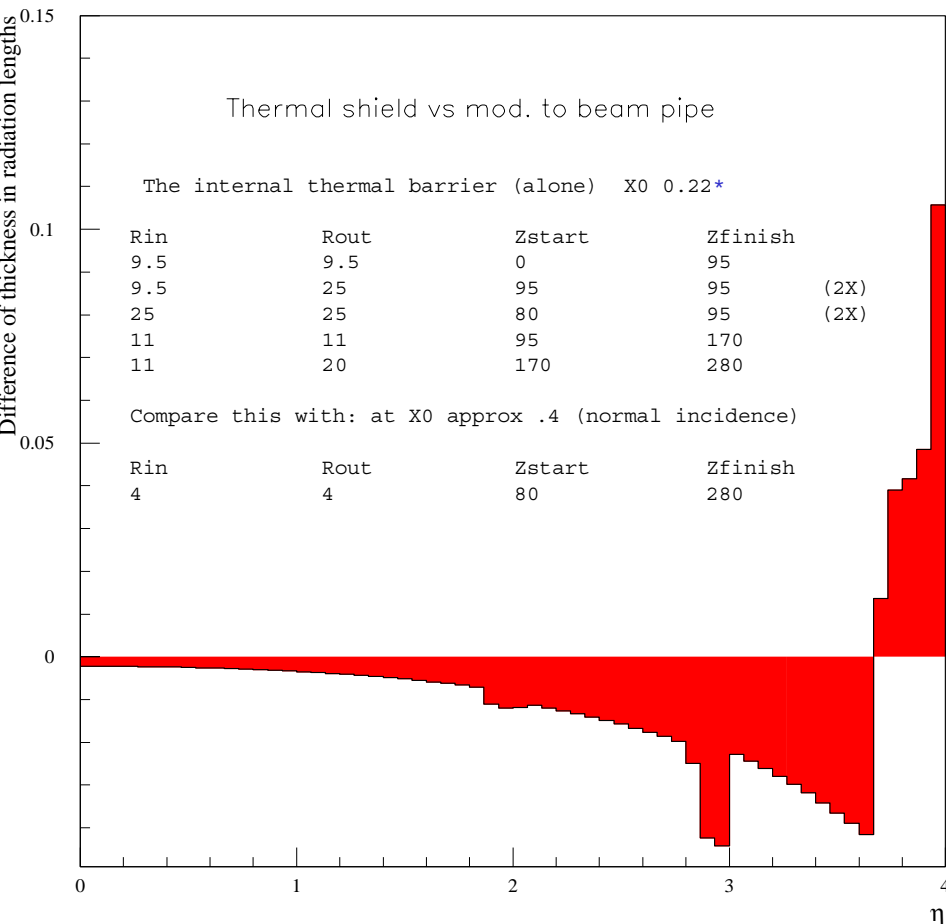
0.376 % X_0 0.5MM BE
STAINLESS FOIL0.375 % X_0

Ti FOIL

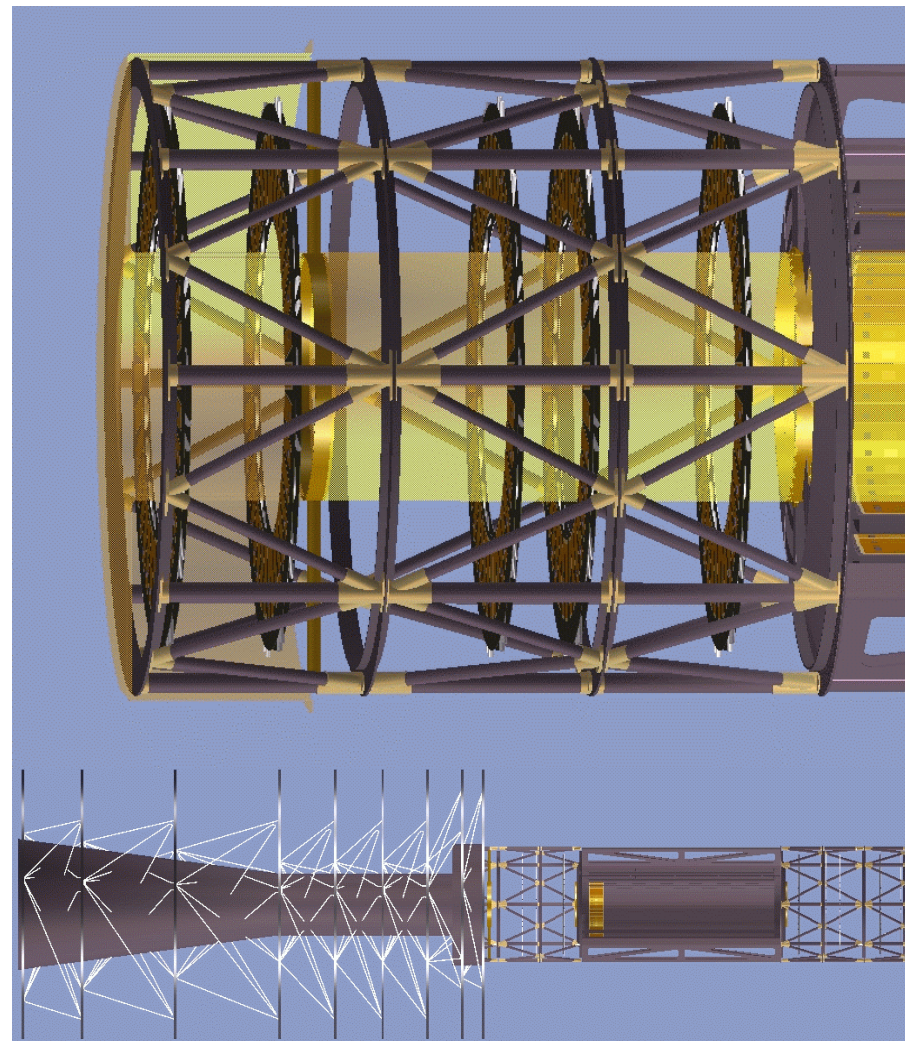
0.270 % X_0

IT IS NOT CLEAR THAT ANY OF THESE DESIGNS IS POSSIBLE
FROM EITHER A VACUUM OR STRUCTURAL POINT OF VIEW
(NO ANALYSIS HAS BEEN DONE)

ESTIMATED MATERIAL TRADEOFFS



*BOTTOM FOUR LINES (TAKEN ONCE) REPRESENT SCT FORWARD THERMAL BARRIER WHICH IS LIKELY TO BE .3% TO .35% X0, NOT THE .22 QUOTED, THIS IS THEREFORE SOMEWHAT CONSERVATIVE



ESTIMATE OF BACK-SCATTER INTO TRT

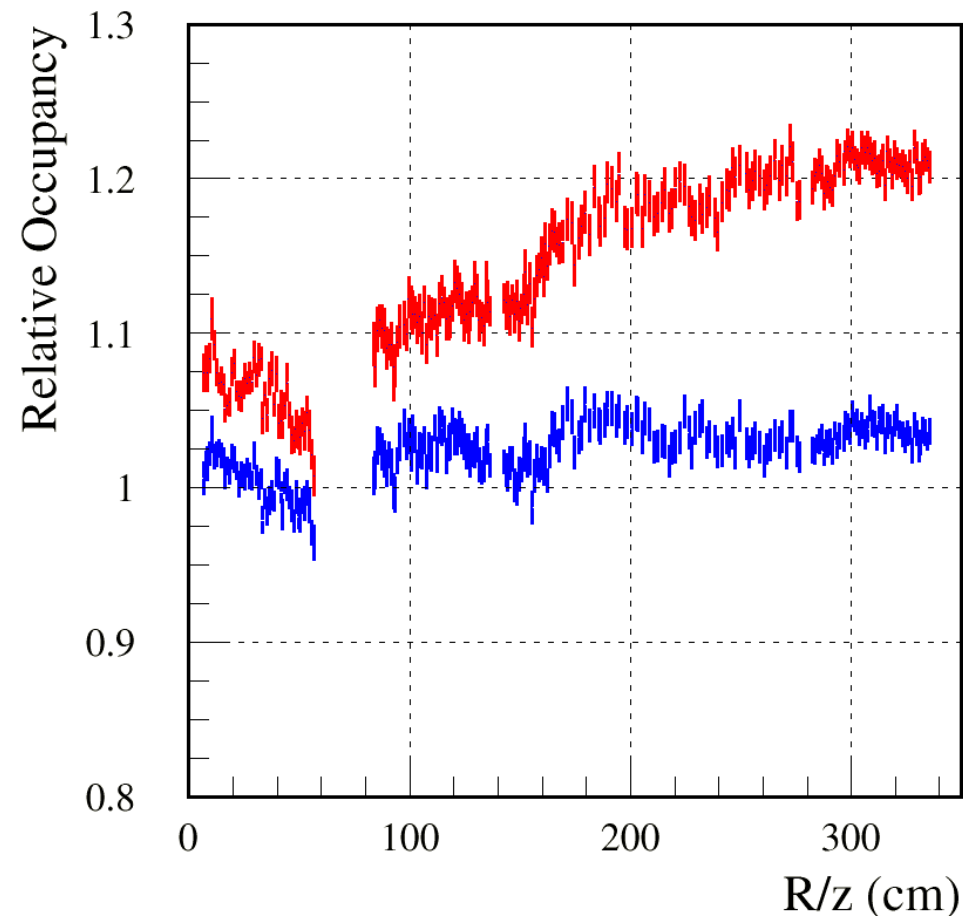


FIGURE 3.6 PIXEL TDR

BLUE LINE REPRESENTS OCCUPANCY OF TRT NORMALIZED ABOUT THE B-LAYER SERVICES ROUTED ALONG THE BEAMPIPE*.

RED LINE REPRESENTS ALL PIXEL SERVICES ROUTED ALONG THE BEAMPIPE (SAME AS B-LAYER)

FOR REFERENCE, EACH OF TWO BARREL-LAYER SERVICE LAYERS HAVE APPROXIMATELY 0.4% XO (NORMAL INCIDENCE AT A RADIUS OF APPROXIMATELY 230MM.) DISK SERVICES ARE APPROXIMATELY .3% XO, AT R=210MM

COMPARE THIS WITH THE APPROXIMATE %XO OF 0.4% AT A RADIUS OF 35MM FOR THE NEG JACKET.

*B-LAYER SERVICES ACTUALLY FAN OUT ALONG SCT THERMAL BARRIER.